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The Canada-Alberta Forest Resource Development Agreement is funded equally by the governments of Canada and Alberta, from April 1, 1984, to March 31, 1989.

Its primary objectives are to ensure the long-term availability of timber supplies; to optimize timber uses; and to contribute to the growth and diversification of Alberta's economy.

The Agreement comprises three programs: Reforestation; Applied research, technology transfer and opportunity identification; and Public information, evaluation and administration. These programs are managed by a joint Directorate and are implemented by the Canadian Forestry Service and the Alberta Forest Service.

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Ses objectifs principaux sont assurer la disponibilité à long terme de réserves de bois; optimiser leur utilisation; et contribuer à la croissance et la diversification de l'économie de la province.

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SPRUCE BUDWORM IN THE FOOTNER

LAKE FOREST - 1987

A STATUS REPORT

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¹ Forest Insect and Disease Survey, Canadian Forestry Service

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ABSTRACT

Historically the spruce budworm (Choristoneura fumiferana [Clemens]) has been a persistent pest in the Wabasca and Chinchaga River valleys of the Footner Lake Forest in Alberta. Mortality of white spruce (Picea glauca [Moench] Voss) has been recorded as high as 39% in some stands following prolonged defoliation. Top kill and growth loss have also been significant. In 1987 budworm defoliation was recorded in 8,640 ha of the Forest, following several consecutive years with no reported defoliation. Subsequent ground surveys detected high population levels, which are expected to persist in some areas in 1988. Preliminary results of spruce budworm pheromone trapping are presented. It is recommended that the spruce budworm be closely monitored in this area.

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TABLE OF CONTENTS

	Page
Disclaimer.	.ii
Abstract.	iii
Acknowledgements.	.iv
List of Tables.	.vi
List of Figures	.vi
Introduction.	1
Previous Spruce Budworm Activity in the Footner Lake Forest	2
Current Conditions/Predictions.	6
Spruce Budworm Pheromone Trapping in Northern Alberta	.13
Literature Cited.	.15

LIST OF TABLES

	Page
Table 1. Wabasca spruce budworm infestation, confluence Wabasca-Muddy Rivers.	4
Table 2. Wabasca spruce budworm infestation, confluence Wabasca-Senex Creek area.	4
Table 3. Current and predicted spruce budworm conditions in the Footner Lake Forest.	10
Table 4. Numbers of spruce budworm moths captured in pheromone traps placed in white spruce stands in Northern Alberta.	14

LIST OF FIGURES

	Page
Figure 1. Frequency of defoliation in the Footner Lake Forest (1958-86). The numbers indicate total years each township has experienced moderate or severe defoliation.	3
Figure 2. Spruce budworm defoliation in FMU F12 of the Footner Lake Forest, 1987.	8
Figure 3. Foliage sample locations, Footner Lake Forest 1987	9

INTRODUCTION

A resurgence of spruce budworm (Choristoneura fumiferana [Clemens]) activity in the Footner Lake Forest of Alberta has raised concerns about the possible impact of this pest on white spruce (Picea glauca [Moench] Voss) stands in the area. To analyze the situation, the Canadian and Alberta Forest Services have intensified their surveys. The results of these surveys and predictions of future population levels are included in this report. A historical perspective of the budworm in the Forest has also been completed. It is hoped that this information can be incorporated into forest management planning. Preliminary results of spruce budworm pheromone trapping in Northern Alberta are presented for information only, since the program has not been in place long enough to properly assess its value as a monitoring and predictive tool.

PREVIOUS SPRUCE BUDWORM ACTIVITY IN THE FOOTNER LAKE FOREST

Current spruce budworm activity in the Footner Lake Forest is not without precedent. A search of the Forest Insect and Disease Survey (FIDS) records show where previous infestations have occurred. This information, complemented by data on the intensity of the infestations can provide forest managers with a historical perspective on spruce budworm activity in the area. This could assist in making logical assumptions as to how the current infestation may develop.

The FIDS records provide information on spruce budworm activities in the Footner Lake Forest from the early 1950s to the present (Anonymous, 1954-1986). In summary, noticeable defoliation activity began in the mid-1950s, but remained relatively minor until the beginning of the next decade. In 1967 the area of defoliation peaked at in excess of 41,000 ha in 12 distinct areas within the Forest. Figure 1 shows two main areas where infestations have persisted with moderate-to-severe defoliation (areas of light defoliation were not included). One is along the Wabasca River and its tributaries in FMU F2, the other is along the Chinchaga in FMU F12 where the current outbreak exists.

Figure 1 shows infestations in FMU F2 that have recurred for up to 7 years (out of a total of 28) in any one township. An even larger area could be involved as it is not always clear from the records whether each area was surveyed every year. Brown (1963) referred to the damaged stands in this area as predominantly overmature white spruce and white spruce-aspen. A series of impact plots were maintained in stands in this area during the 1960s (Stevenson, 1970). Table 1 summarizes data collected from plots within the most heavily defoliated portions of the outbreak area.

Figure 1. Frequency of defoliation in the Footner Lake Forest (1958-1986). The numbers indicate total years each township has experienced moderate or severe defoliation.

This might represent the worst-case scenario for spruce budworm damage in the area; (i.e. the infestation was both intense and prolonged). The data shown in Table 2 was gleaned from stands subjected to less persistent defoliation.

Table 1. Wabasca spruce budworm infestation, confluence Wabasca-Muddy Rivers.

Year	Total Trees	% Mortality Dom. & Codom.	% Live Trees With Dead Tops
1962	174	5.0	18.0
1965	190	6.3	18.9
1967	304	34.0	49.0
1968	383	39.0	44.0

(from Stevenson, 1970)

Table 2. Wabasca spruce budworm infestation, confluence Wabasca-Senex Creek area.

Year	Total Trees	% Mortality Dom. & Codom.	% Live Trees With Dead Tops
1962	117	2.6	18.8
1965	128	3.1	18.6
1967	99	9.9	34.0

(from Stevenson, 1970)

It usually takes 6 to 7 consecutive years of severe defoliation to kill a white spruce (Witter et. al., 1984), while dead tops may occur after 3 years (Cerezke, 1976). This would appear to have been the case in the stands referred to in Table 1, as there was a noticeable increase in mortality between 1965 and 1967. Trees in lower crown classes (including those in the regeneration stage) suffer more severely than those in the upper crown class. This is because larvae drop from adjacent trees onto trees with a lower ability to cope with defoliation due to sparse foliage and competitive stress (Cerezke, 1976). Cerezke (1976) maintained that in the case of understory trees, mortality can occur after 5 consecutive years of severe defoliation and topkill after 2. Trees not killed by defoliation can suffer reductions in annual increment; the degree of which is dependent on the duration and intensity of the outbreaks (Stevenson, 1976). This can have serious detrimental effects on vigour and growth.

CURRENT CONDITIONS/PREDICTIONS

During the first two weeks of June, 1987 spruce budworm pheromone baited traps were placed at various locations throughout the province as part of an ongoing monitoring project. Trap deployment in the Footner Lake Forest was done in conjunction with the aerial survey of the Chinchaga, Steen and Wabasca river valleys, conducted annually since 1984. A helicopter was provided by the Alberta Forest Service for this survey. At that time light-to-moderate defoliation was noted along the Chinchaga River in the vicinity of the bridge on Highway 58 and continued upstream in Townships 110, 109, and 108 and downstream through most of Township 111, Ranges 2 and 3.

In July of 1987 the Alberta Forest Service at Footner Lake surveyed the infestation from the air and prepared detailed maps denoting areas of light, moderate and severe defoliation using 1:50,000 scale forest cover type maps. The total infestation covered approximately 8,640 ha, of which 5,790 ha were rated moderate or severe, and 2,850 ha as light (Figure 2).

From these maps 11 sampling locations were selected to include all categories of defoliation (Figure 3). On September 10 five trees at each location were sampled by removing two 45 cm branches on opposite sides near the mid-crown of each tree. The branches were bagged, labelled, and returned to the Northern Forestry Centre for defoliation estimates and budworm population measurements.

The budworm counts were used to assess current budworm conditions and to make predictions of population levels to occur in 1988. Both current and forecasted conditions are presented in Table 3.

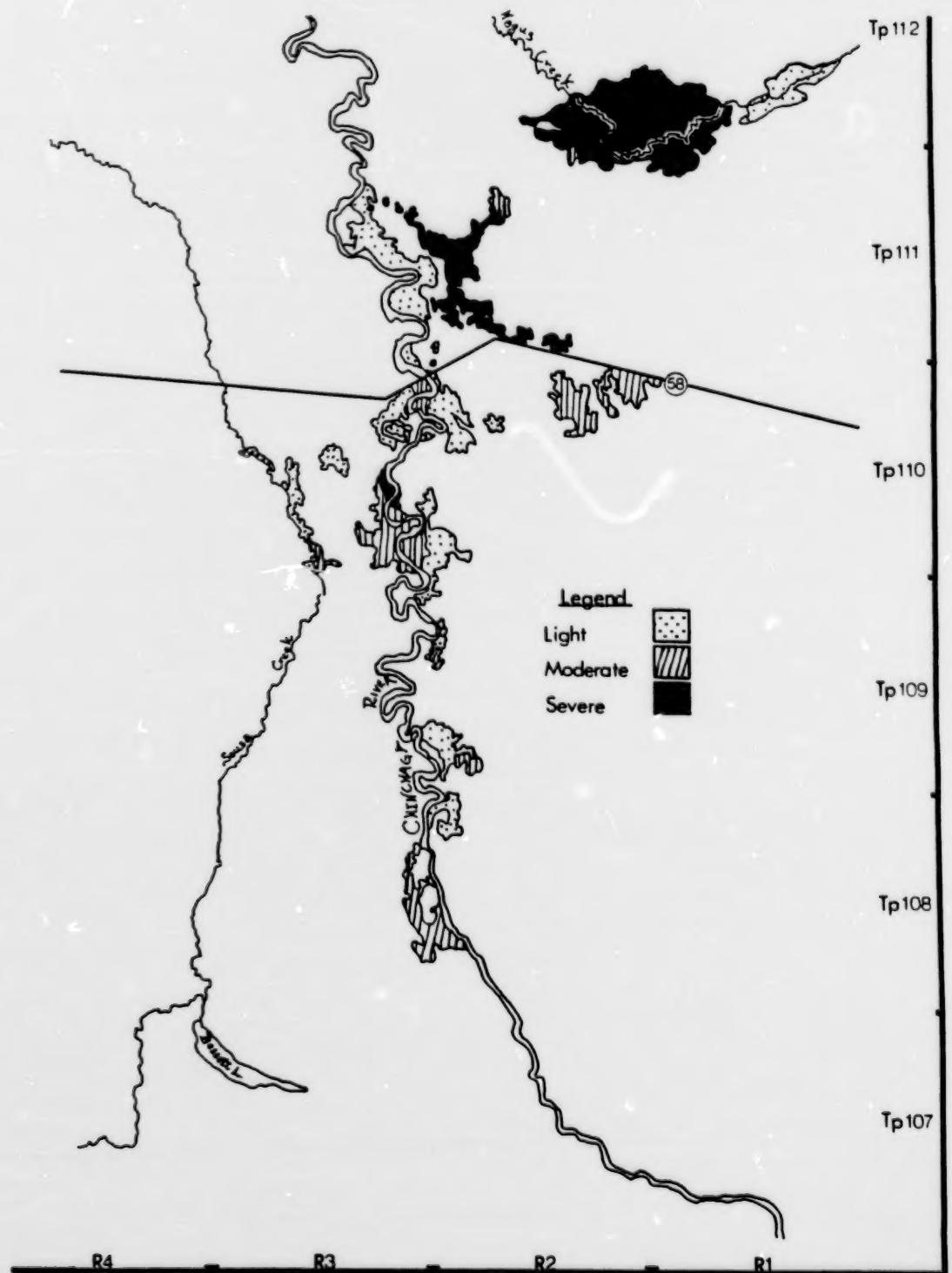


Figure2. Spruce budworm defoliation in FMU F12 of the Footner Lake Forest, 1987.

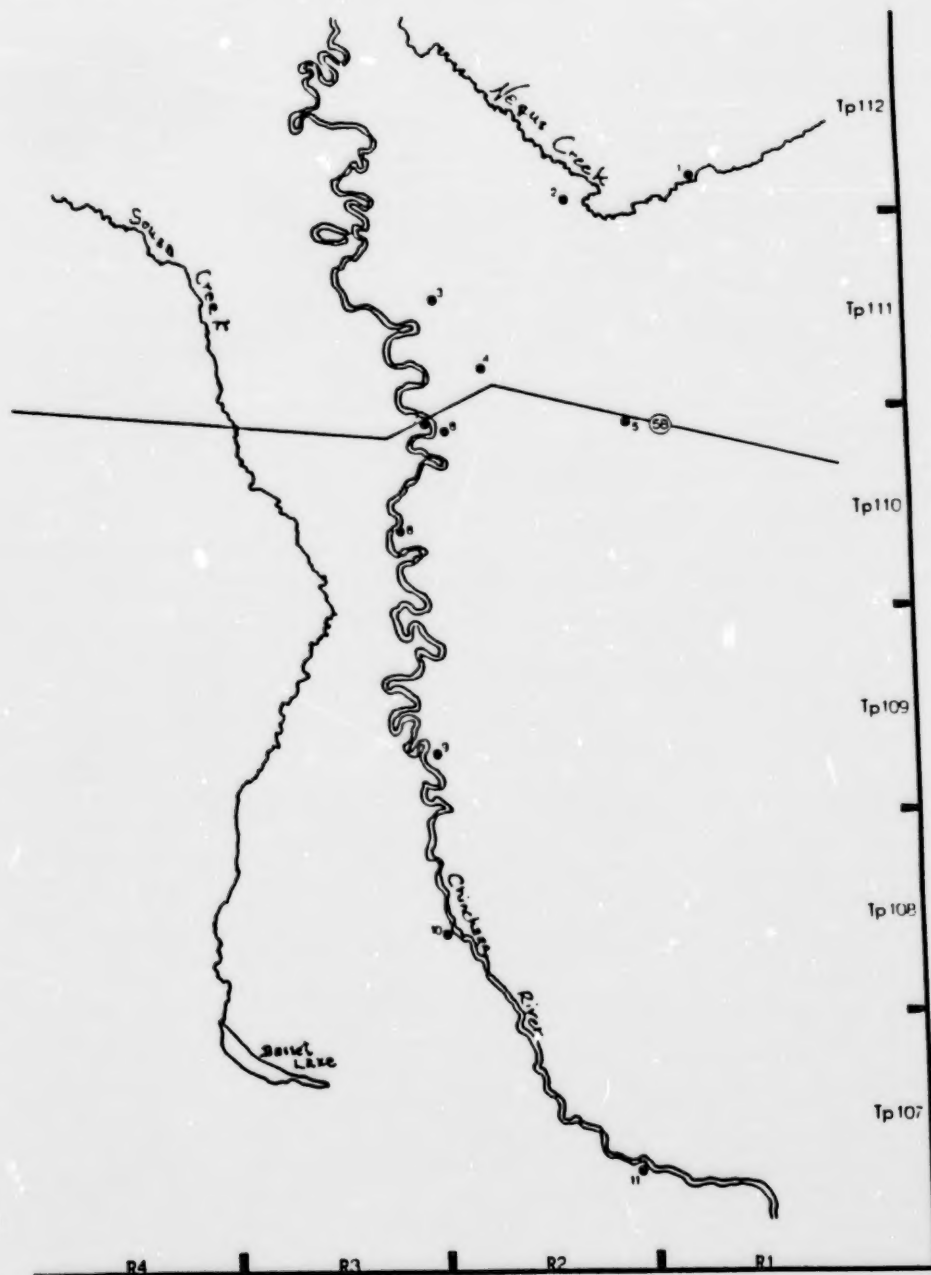


Figure 3. Foliage sample locations, Footner Lake Forest 1987.

Table 3. Current and predicted spruce budworm conditions in the Footner Lake Forest.

LOCATION SEC-TWP-RG.	DEFOL. CATE.	%DEFOLIATION (FETTE'S METHOD)	EGG MASS PER 10 M ²	NO LARVAE PER 10 M ²	1988 FORECAST	
					EGG	LARVAE
1. (9-112-1-W6)	sev	43.4 (mod)	242.6	270.0	sev	mod
2. (2-112-2-W6)	sev	51.8 (mod)	120.0	193.0	mod-sev	mod
3. (17-111-2-W6)	sev	39.2 (mod)	66.9	340.3	mod	sev
4. (4-111-2-W6)	sev	35.2 (mod)	665.5	2382.0	sev	ext
5. (36-110-2-W6)	mod	35.8 (mod)	9.7	124.2	light	mod
6. (31-110-2-W6)	light	55.2 (mod)	397.8	1613.0	sev	ext
7. Chinchaga R. Bridge	mod	22.7 (light)	193.8	313.0	mod-sev	mod
8. (13-110-3-W6)	sev	53.4 (mod)	357.2	635.7	sev	sev
9. (7-109-2-W6)	mod	41.2 (mod)	203.0	393.0	sev	sev
10. (18-108-2-W6)	mod	35.5 (mod)	42.9	37.3	light-mod	light
11. (12-107-2-W6)	control	4.1 (light)	0.0	0.0	nil	nil
Steen River	nil	7.7 (light)	12.7	35.0	light	light
Hutch Lake	nil	18.4 (light)	3.9	17.3	light	light

The defoliation rates presented in Table 3 were based on two separate techniques; those outlined in Column 2 are based on the visual estimates made by Alberta Forest Service personnel during aerial sketch-mapping. In aerial sketch mapping a 'severe' defoliation category includes trees exhibiting complete defoliation of the current years' shoots over the entire crown; 'moderate' by trees having defoliation easily visible in the tops of the trees and moderate-to-slight discolouration of foliage in lower portions of the tree; and 'light' includes trees which have defoliation visible only in the tops of the trees. These estimates were the basis for stratifying stands for further sampling. No tree mortality or top kill was evident in 1987.

The estimates calculated for Column 3 were made using the Fettes' Method. This requires examining the current years' shoots on the collected branches for the percentage of needles removed from each. These values are averaged to get a branch rating, and in turn the branches averaged to get a stand rating. The stand defoliation is then classed as light, moderate, or severe depending on whether the average was 0-35, 36-70, or 71-100% defoliation respectively. Minor differences between these estimates and the aerial estimates are not unexpected.

Egg mass counts (Column 4) were based on numbers of new egg masses (as evidenced by colour, fullness and the presence and colour of larval remains) on the sample foliage. All branches examined were 45 cm in length, with a width measurement being made at the widest point. These two measurements provided a branch area (M^2) which was used to calculate the number of egg masses per 10 M^2 as follows:

$$\text{No of egg masses per } 10 \text{ M}^2 \text{ of foliage area} = \frac{10}{\text{Branch Area (M}^2\text{)}} \times \text{No. Egg Masses}$$

The following criteria were used to make predictions (Column 6) based on the results of the egg mass counts:

Light = Up to 25 egg masses per 10 M² of foliage.

Moderate = 50 to 100 egg masses per 10 M² of foliage.

Severe = 200 + egg masses per 10 M² of foliage.

Intermediate categories (light-mod and mod-sev) were used when egg mass counts fell between class boundaries.

Spruce budworm larvae (Column 5) were extracted from the sample branches using a washing procedure. The same formula was used to calculate the number of larvae per 10 M² as was used to calculate egg masses per 10 M².

$$\text{No. of Overwintering Larvae per } 10 \text{ M}^2 \text{ of foliage area} = \frac{10}{\text{Branch Area (M}^2\text{)}} \times \text{No. of Larvae}$$

The following criteria were used to make predictions (Column 7) based on the number of overwintering larvae detected by the larval washes:

<u>Overwintering Larvae/10 M2</u>	<u>Infestation Level</u>	<u>Expected Defoliation (%)</u>
1 - 108	Low	1 - 30
109 - 323	Moderate	31 - 65
324 - 700	Severe	66 - 90
701 +	Extreme	90 - 100

The forecasts for 1988 indicate the infestation will continue. Many of the areas sampled are predicted to experience higher population levels than in 1987. There are a number of factors that can adversely affect budworm population levels before the next larval feeding period. It is for this reason that the levels forecast are not a certainty. It is, however, recommended that Forest Service personnel in the area remain cognizant of budworm conditions. Survey activity in 1988 should be similar to that of 1987, or be expanded if there are indications that the outbreak is expanding. Some advance planning/discussion of management options in the event of a persistent infestation may also be in order. Consideration should also be given to the fact that defoliation can predispose trees to other pests such as bark beetles and fungi.

SPRUCE BUDWORM PHEROMONE TRAPPING IN NORTHERN ALBERTA

The FIDS unit at the Northern Forestry Centre instituted a program to monitor the spruce budworm using pheromone baited traps in 1985, after being involved in the testing of various baits and trap designs. The trap adopted was the Multi-pher-1 plastic canister non-saturating design. It consists of a covered canister baited with a polyvinylchloride (PVC) pellet which has an attractant blend incorporated at the time of manufacture. The concentration of the pheromone blend is 0.03% by weight. Moths that enter the trap are killed by dichlorvos fumes released from an impregnated resin strip placed in the trap. The dead moths collect in the bottom of the canister. For further information on this and other aspects of the spruce budworm pheromone trapping procedure Allen et. al. (1986) should be consulted.

The ultimate goal of the pheromone trapping program is to develop the capability of predicting the density of subsequent budworm populations based on the number of moths captured in a stand. As information is collected and trap catches are correlated with other indices of population density such as egg mass surveys and larval washes the predictive potential of the system may be developed. Our ability to make logical assumptions regarding trap catches is limited, as the program is relatively new and there is a lack of data. There were, however, some relatively large moth catches at two sites (Chinchaga and Steen Rivers) within the Footner Lake Forest in 1985 (Table 4).

Table 4. Numbers of spruce budworm moths captured in pheromone traps placed in white spruce stands in Northern Alberta.

Site	FMU	Moths/Trap		
		1985	1986	1987
Thickwood Hills	A5	2.3	2.7	0.0
Draper Crossing	A3	0.3	0.3	0.0
Ft. McKay	A7	2.0	0.3	0.0
Steen River	F9	80.7	1.0	12.7
Chinchaga River	F12	281.3	17.7	74.0
Hutch Lake	F15	14.7	1.0	1.7
Senex Creek	F2	-	1.3	0.0
Freeman River	W3	-	25.3	10.7
Fox Creek	W2	-	18.5	5.3
Little Smoky	G5C	-	11.0	0.3
House River	L3	-	0.0	0.0

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